Technology I / II
Architecture 207-309 (undergraduate sophomore year, also open to non-majors)
Architecture 507-509 (graduate option 1 first year, open to non-majors with approval)

Instructor: Christof Spieler, P.E., LEED AP

The intent of this two-semester sequence is to introduce students to structural concepts that can be applied to a wide range of buildings. These concepts are placed in a context of material properties, natural forces, industrial systems, construction techniques, economic imperatives, sustainability, programmatic requirements, and architectural ideas to examine what factors drive the selection of structural systems.

Lectures focus on structural concepts, illustrated with wide variety of built examples from throughout the world. The final exams at the end of each semester cover the same material as the lectures. 8 homeworks throughout each semester focus on calculation. Field trips will include construction sites and fabrication firms. Each semester includes a design project to design, detail, and calculate a structural system for a selected program. The proposed system is critiqued in class for its feasibility, economy, and architectural potential. Independent research is expected. Design software is an integral part of the course. Rhino will be used for design. Homework will include the use of RISA-3d, a powerful structural analysis package that will also be used for the final projects.

Sustainability topics, including use of natural resources, energy consumption, transport, and reuse, are emphasized and are integrated throughout the course.

ARCH 207/507: The Frame (Fall 2013)
The first semester explores the trabeated frame as a structural system.

Introduction: history of structural engineering, the language of structures
I. Walls
- *Gravity Loads*
- *Load bearing walls*
- *Masonry*

II. Beams
- *Beams*
- *Moment*
- *Wood*

III. Pinned frame
- *Pinned frames*
- *Steel*
- *Compression*
- *Foundation*
- *Earthquake and Hurricane loads*
- *Shearwalls and braces*

IV. Truss
- *Trusses*

V. Highrise
- *The history of highrise*

Conclusion: economics

ARCH 309/509: The Shell (Spring 2014)
The second semester explores the consequences of continuous structures and rigid connections, then moves on to non-orthogonal and undifferentiated systems.

Introduction: the tyranny of the grid
VI. Rigid Frame
- *Rigid frames*
- *Concrete*

VII. Slab
- *Slabs*
- *Post-Tensioning*

VI. Curved Frame
- *Curved*
- *Connections*

X. Shell
- *Arches/Domes/shells*
- *Tensile*

XI. Integrated skins
- *Monocoque*
- *Tiltwall, SIP, and ICF*
- *Tall walls*
- *Diagrid/shear plane*
- *Hybrid systems*

VIII. Longspan
- *Longspan buildings*
- *1000 ft bridges*

Conclusion: Architect vs. Engineer

Upon completion of this sequence, a student is expected to:
- Understand the basic principals of structural behavior.
- Understand the properties, behaviors, and attributes of common structural materials.
- Understand the process of design, fabrication, and erection of structural systems.
- Be able to select a reasonable structural system for a particular building.
- Be able to roughly size members for a structural system.
- Be able to detail common structural systems.

Owlspace and Email
Class schedules, assignments, and announcements will be posted on Owlspace. Students are expected to check Owlspace for updates. All students are expected to check their Rice email accounts. Individual communications may come through email.

Grading (207/309)
Class grade is based on:
- A three-part design project (40%) [200 points part II, 200 points part III]
- A final exam (30%) [300 points]
- Homeworks (20%) [8 @ 25 points each]
- Attendance (10%) [100 points]

Grading (507/509)
Class grade is based on:
- A structural system research project (10%) [100 points]
- A three-part design project (30%) [150 points part II, 150 points part III]
- A final exam (30%) [300 points]
- Homeworks (20%) [8 @ 25 points each]
- Attendance (10%) [100 points]

Grading scale
The total number of points will be noted on each assignment, on the project, on attendance, and on the exam. The preliminary grading scale is as follows:
90% or above: A
80%-89%: B
70%-79%: C
60%-69%: D
59% or below: F
This range may be adjusted downwards but not upwards.

Homeworks
Homeworks will be based on calculations. They will be tied to class content and readings but will not be directly explained in class. All homeworks can be re-submitted (once) after being graded: a student can redo whatever they got wrong and turn in again for full credit. This is only valid if the initial submission is one time and complete (though incorrect). If a student does not follow the requirements for how to submit the assignment (turns in a .jpg instead of a pdf, turns in multiple pdfs instead of one) they will be graded 0.

Final exam
The exam will be based on lecture content. It will include short answer and essay questions. The powerpoint slides shown in class will be posted for exam review, and a review exam (with different questions than the exam) will be posted as well. The exam is on Owlspace; it is a take-home and can be taken any time between the last day of class and the end of finals period.

Project
Each semester's project consists of the structural design of a building for an assigned program. Each will be assigned in three parts. The first consists of a meeting with the instructor, the second of a juried design presentation, and the third of a complete set of calculations using RISA.
207/507 students will be assigned an additional project consisting of a report on an assigned structural system based on research and calculation.

Attendance
The attendance portion of the class (10% of the class grade) will be graded as follows:-2 or fewer absences - full credit-3 or 4 absences - 50% credit-more than 4 absences - no creditAccommodations may be made for illness or academic-related absences. If you will miss class for these reasons, email me (spieler@rice.edu) with "absence" in the subject line before class starts.It will be difficult to do well on the exam without attending the lectures. Any student who will miss a class can contact the instructor for alternatives.

Honor code
The extent of collaboration permitted on each assignment, project, and exam will be indicated with that assignment, project, or exam.

Accommodations for disability
Any student with a documented disability seeking academic adjustments or accommodations is requested to speak to the instructor during the first two weeks of class. All such discussions will remain as confidential as possible. Students with disabilities will need to also contact Disability Support Services in the Allen Center.

Contact info
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Prerequisites
This class is open to architecture majors as well as non-majors. There are no prerequisites.

Textbook
The following texts are assigned for the class:

- "Architectural Structures," Wayne Place, 2007
- "Understanding Steel Design: An Architectural Design Manual," Terri Meyer Boake, 2011

The following text is recommended:

- "The Function of Form," Farshid Moussavi, 2009.

Texts may be purchased on Amazon.

Additional readings will be distributed.

	Class		Project	Assignments assigned		due	Readings	
							Architectural Structures	*Understanding Steel Design*
Tuesday, August 21, 12	1	Intro						
Thursday, August 23, 12	2	language		1	Equilibrium		Sections 1.1-1.8, 2.1, 2.2.1-2.2.3, 3.1-3.3	
Tuesday, August 28, 12	3	load bearing wall		2	Vectors		Section 4.1	
Thursday, August 30, 12	4	gravity loads		3	Loads			
Tuesday, September 4, 12	5	timber frame				1	Section 4.2	
Thursday, September 6, 12	6	steel					Section 4.3	Chapter 1, "The Transformative Nature of Steel Construction" and Chapter 2, "The Materiality of Steel"
Tuesday, September 11, 12	7	compression		4	Tension and Columns	2	Sections 5.1-5.4	
Thursday, September 13, 12	8	bending		5	Beams - moment		Sections 6.1-6.3	
Tuesday, September 18, 12	9	pinned frame	assign project	6	Beams - sections	3		Chapter 3, "Connections and Framing Techniques"
Thursday, September 20, 12	10	truss					Sections 7.1-7.5	Chapter 5, "AESS: Its History and Development"
Tuesday, September 25, 12		WPBD				4		
Thursday, September 27, 12		WPBD		7	WPBD			
Tuesday, October 2, 12	11	hurricanes				5	Section 2.2.5	
Thursday, October 4, 12	12	earthquakes		8	Physical models		Section 2.2.6	
Tuesday, October 9, 12	13	lateral				6	Sections 10.1-10.2	
Thursday, October 11, 12		no class						
Tuesday, October 16, 12		no class				7		
Thursday, October 18, 12		no class						
Tuesday, October 23, 12		model presentations	project meetings			8		
Thursday, October 25, 12	14	foundations	project meetings					
Tuesday, October 30, 12		project presentations	project presentations					
Thursday, November 1, 12		project presentations	project presentations					
Tuesday, November 6, 12		project presentations	project presentations					
Thursday, November 8, 12		project presentations	project presentations					
Tuesday, November 13, 12	15	brief history of tall						
Thursday, November 15, 12		no class						
Tuesday, November 20, 12	16	high cost of tall						
Thursday, November 22, 12		no class						
Tuesday, November 27, 12		no class						
Thursday, November 29, 12		no class						
Wednesday, December 5, 12		Start of finals						
Wednesday, December 12, 12		End of finals						

	Class		Project	Assignments assigned		due	Readings Architectural Structures	Understanding Steel Design
Tuesday, January 8, 13	1	why you can't afford curves		1	Wind loads			Chapter 4, "Fabrication, Erection, and the Implications of Design"
Thursday, January 10, 13	2	concrete		2	Continuous beams		Section 4.4	
Tuesday, January 15, 13	3	rigid frame		3	Rigid Frame		Section 6.4	
Thursday, January 17, 13	4	slabs		4	Slab			
Tuesday, January 22, 13	5	curved						Chapter 8, "Curved Steel"
Thursday, January 24, 13		field trip TBD						Chapter 8, "Curved Steel" Chapter 10, "Castings", Chapter 13, "Advanced Framing Systems: Steel and Timber"
Tuesday, January 29, 13	6	connections						
Thursday, January 31, 13		systems presentations						
Tuesday, February 5, 13		systems presentations						
Thursday, February 7, 13		no class						
Tuesday, February 12, 13	7	arches		5	Curves		Section 8.1	
Thursday, February 14, 13		in-class design	project assigned	6	In-Class design		Section 8.2	
Tuesday, February 19, 13	8	shell						
Thursday, February 21, 13	9	tensile		7	Tensile		Sections 9.1-9.2	Chapter 11, "Tension Systems and Spaceframes"
Tuesday, February 26, 13		no class						
Thursday, February 28, 13		no class						
Tuesday, March 5, 13	9	shear plane	project meetings					Chapter 9, "Diagrids"
Thursday, March 7, 13	10	new wall	project meetings					
Tuesday, March 12, 13	11	monocoque		8	Monocoque			
Thursday, March 14, 13		project presentations	project presentations					
Tuesday, March 19, 13		project presentations	project presentations					
Thursday, March 21, 13		project presentations	project presentations					
Tuesday, March 26, 13		project presentations	project presentations					
Thursday, March 28, 13		no class						
Tuesday, April 2, 13	12	tall wall						Chapter 12, "Steel and Glazing Systems"
Thursday, April 4, 13	13	1000 feet						
Tuesday, April 9, 13	14	longspan						
Thursday, April 11, 13	15	conclusion						
Tuesday, April 16, 13		no class						
Thursday, April 18, 13		no class						
Tuesday, April 24, 13		Start of finals						
Tuesday, May 1, 13		End of finals						